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Channels and Fan-like Features on Titan Surface Imaged by the Cassini RADAR

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The Cassini Titan Radar Mapper acquired Synthetic-Aperture Radar (SAR) data during two close flybys of Titan on October 2004 (Ta), and February 2005 (T3), revealing Titan's complex surface and intriguing geological features. The SAR mode operates at altitudes less than 4000 km with resolution varying from 400 m to 1 km. Images are acquired either left or right of nadir, with 2 to 7 looks, by a five beams antenna with swath width of 120-450 km and length of 4000-6000 km. The effective resolution of the images is defined by a combination of surface range and surface azimuth resolution which varies throughout the encounter with time.

Fine surface features have been identified and outlined, mainly in the portion of the images characterized by higher resolution, which include fan-like features and connected sinuous and linear channels which show SAR-bright return and high contrast with respect to the surrounding SAR-dark material. The sinuous and linear channels are on average 500 m to 1 km across and extend for several tens of kilometers, while the fan-like features extend for a few tens of kilometers and seem to open at a possible change in topography on a sloping surface facing ENE (i.e. Ta flyby).

The observed variations in radar backscatter derive from a combined effect of surface roughness and topographic variation, dielectric properties of unusual materials (water ice, water-ammonia ice and other ice, hydrocarbons, tholins). However, volume scattering might play an important role and contribute to the high backscatter return, especially in the presence of absorbing-porous materials on the surface. The observed strong correlation of SAR-bright and radiometric cold regions suggest volume scattering as due to broken low-loss ices and resulting low emissivity as with the surfaces of Europa and Ganymede, rougher terrain, or higher dielectric constant materials.

We suggest two possible explanations for the SAR-bright response that are also consistent with the radiometry data. The first implies that the SAR-bright return is associated with a high component of volume backscattering possibly due to presence of low absorbing-porous material with a mixture of low and high dielectric constant (i.e. snow and fractured ice). The second implies that the SAR-bright return results from a high component of volume backscattering derived from fluvially-transported and deposited heterogeneous materials (ice-rocks) of a size greater than the operational radar wavelength of 2.17 cm. Here, the SAR-bright sinuous and linear features might be associated with “fluvial” (most likely, hydrocarbon) channels and the fan-like features then be alluvial in nature.